Designing Optimal Pension Systems

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Introduction

Labor supply decisions are affected by ..

- labor income taxes - primarily via intensive labor supply margin
- pension system - primarily via extensive labor supply margin

Question

- What does optimal policy look like with both intensive and extensive margins of labor supply?

Approach:

- integrate extensive margin of labor supply into Mirrleesian framework

Preview of results

We develop a theoretical framework that..

- provides a direct test of whether a pension system is Pareto optimal
  - a simple testable relationship between intensive and extensive labor distortions and labor supply elasticity that any Pareto optimal system must satisfy
- qualitatively justifies large disincentives to work after retirement
  - a jump in taxes after retirement age

Note: first statement is about optimal allocation, second about implementation

Outline of the rest of the talk

1. Full information benchmark
2. Adding private information
3. Optimal Allocations
4. Implementation
5. A way forward

Full Information Benchmark

Setup

- Time: $t \in [0, \infty)$
- At each date a generation is born with mass 1
- Each generation lives for 1 unit of time from t to $t + 1$
- Each agent in generation t has a type $j \in \{1, \cdots, n\}$
- Measure π_j of agents of type j

Consumers

- $c_t(a, j)$: consumption of agent born at t, age a, type j
- $l_t(a, j)$: hours worked

- Preferences:

$$\int_0^1 e^{-\rho a}[u(c_t(a, j)) - \tilde{v}(l_t(a, j))]da$$

  - $u(\cdot)$: C^2, st. inc and concave, $u'(0) = \infty$

- Fixed cost of entering work force:

$$\tilde{v}(l) = v(l) + \eta \cdot \mathbf{1}_{[l>0]}$$

  - $v(\cdot)$: C^2, st. inc and convex, $v'(0) = 0$

Technology

- Aggregate production function:

$$F(K, L) = (1 + r)K + L$$

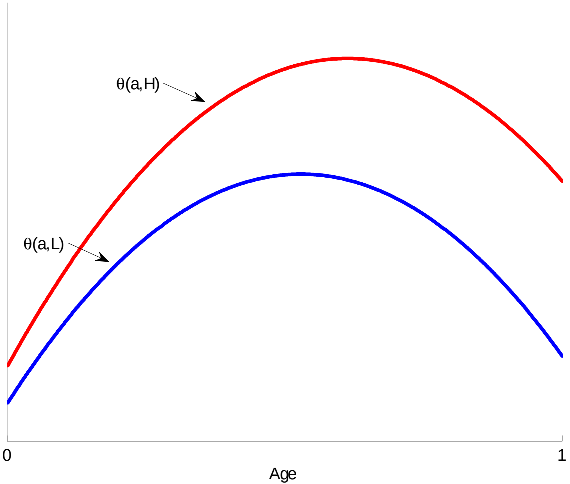
where L is total effective hours worked

$$L = \sum_{j=1}^{n} \pi_j \theta(a, j) l(a, j)$$

  - $\theta(a, j)$ is productivity profile over life cycle

Productivity profile over life cycle

$\theta(a, j)$ is inverse-U-shaped in age dimension



A modification - taste shocks

- We focus on a version of the model with taste shocks, ϕ
- Preferences of a j-type agent:

$$\int_0^1 e^{-\rho a}\left[u(c_t(a,j)) - \phi(a,j)v(y_t(a,j)) - \eta \mathbf{1}_{[y_t(a,j)>0]}\right] da$$

  - where y is output and $\phi(a,j)$ is U-shaped along a-dimension

- If $v(l) = l^{1+\gamma}/(1+\gamma)$, then setting $\phi(a,j) = \frac{1}{\theta(a,j)^{1+\gamma}}$ makes the two formulations equivalent

Simplifying assumptions

- $\rho = 0$, $r = 0$
  - no growth in consumption
  - indifference in timing of labor supply
- Focus on stationary allocations $\{c(a,j), l(a,j)\}$
  - since no aggregate uncertainty, no growth

Adding Private Information

Adding private information

- Type is unobservable
- Age, consumption, and output are observable
- If type j pretends to be i, he receives allocation $\{c(a,i), y(a,i)\}$ for all $a \in [0,1]$
- Incentive constraints, for all j

$$j \in \arg\max_i \int_0^1 [u(c(a,i)) - \phi(a,j) v(y(a,i)) - \eta \mathbf{1}_{[y(a,\theta)>0]}] da$$

Mechanism design problem

$$\max_{c(a,j),y(a,j)} \sum_j \pi_j \int_0^1 [u(c(a,j)) - \phi(a,j)v(y(a,j)) - \eta \mathbf{1}_{[y(a,j)>0]}]da$$

s.t.

$$\sum_j \pi_j \int_0^1 c(a,j)da + G \leq \sum_j \pi_j \int_0^1 y(a,j)da$$

$$j \in \arg\max_i \int_0^1 [u(c(a,i)) - \phi(a,j)v\,(y(a,i)) - \eta \mathbf{1}_{[y(a,i)>0]}]da$$

- main results hold for any welfare weights

Optimal Allocations

Full information allocation

- Full insurance: $c(a,j) = c$, $\forall a, j$

- Consumption-intensive-labor trade-off:

$$u'(c) = \phi(a,j)\, v'(y(a,j))$$

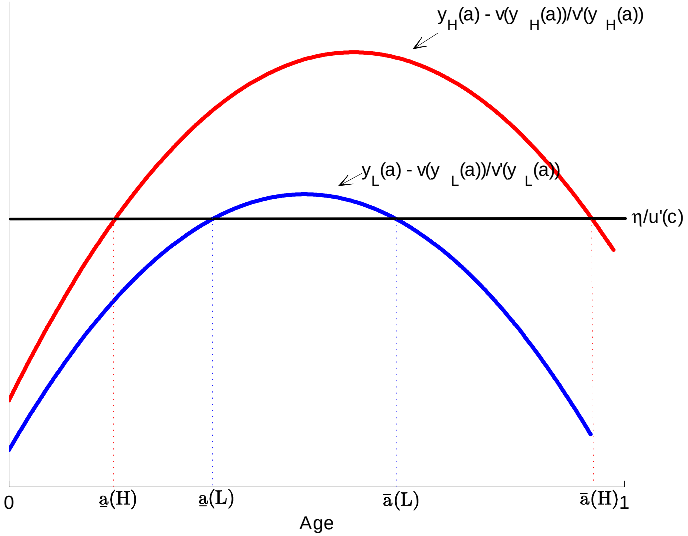
- Consumption-extensive-labor trade-off: $\forall j\ \exists \underline{a}_j, \bar{a}_j$ s.t. for $a \in \{\underline{a}_j, \bar{a}_j\}$

$$u'(c) y(a,j) = \phi(a,j)\, v(y(a,j)) + \eta$$

- Extensive Margin Equation, for $a \in \{\underline{a}_j, \bar{a}_j\}$:

$$y(a,j) - \frac{v(y(a,j))}{v'(y(a,j))} = \frac{\eta}{u'(c)}$$

Two-type illustration



Private information allocation - consumption/savings

- $c(a, j) = c(a', j) = c(j)$ for all $a, a' \in [0, 1]$ except for a measure 0 subset
- No intertemporal shocks $\Rightarrow$ no saving distortions

Private information allocation - labor supply

- No distortion at the top along both margins
- Positive consumption-intensive-labor wedge for everyone else

$$u'(c(j)) > \phi(a,j)v'(y(a,j))$$

define

$$1 - \tau_l(a,j) = \frac{\phi(a,j)v'(y(a,j))}{u'(c(j))}$$

Private information allocation - labor supply

- Positive consumption-extensive-labor wedge for everyone but top type, for $a \in \{\underline{a}_j, \bar{a}_j\}$

$$u'(c(j))y(a,j) > \phi(a,j)v(y(a,j)) + \eta$$

define

$$1 - \bar{\tau}(j) = \frac{\phi(\bar{a}_j, j)v(y(\bar{a}_j, j)) + \eta}{y(\bar{a}_j, j)u'(c(j))}$$

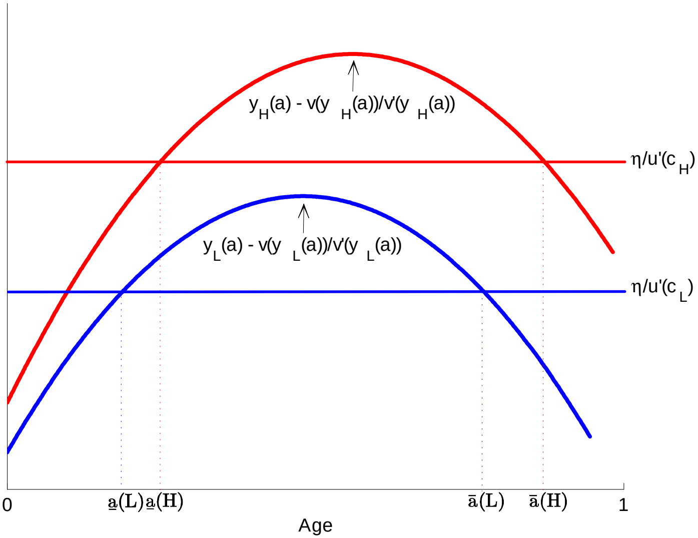
and similarly $\underline{\tau}$

Private information allocation - labor supply

- Extensive Margin Equation, for $a \in \left\{\underline{a}_j, \bar{a}_j\right\}$

$$y(a,j) - \frac{v(y(a,j))}{v'(y(a,j))} = \frac{\eta}{u'(c(j))}$$

Two-type illustration



Main result - allocation

Theorem

In any constrained efficient allocation, independent of Pareto weights and η, wedges satisfy

$$\bar{\tau}(j) = \tau_l(\bar{a}, j) \frac{1}{\varepsilon(\bar{a}, j)}$$

where $\varepsilon(\bar{a}, j) = v'(y(\bar{a}, j))\, y(\bar{a}, j) / v(y(\bar{a}, j))$, *and similarly for* $\underline{\tau}$.

- Proof: follows from Extensive Margin Equation and the definitions of wedges.
- If $v(y) = y^{1+1/\gamma} / (1 + 1/\gamma)$, with constant Frisch elasticity of labor supply γ, then

$$\bar{\tau}(j) = \tau_l(\bar{a}, j) \frac{\gamma}{1+\gamma}$$

Implementation

Implementation

- Try to use policies similar to the ones used in practice
  - nonlinear, progressive taxes on earnings, Social Security or similar pension system
- Implementation depends on market structure
  - we provide an important benchmark of no insurance markets before agents' birth
  - assume equal welfare weights for simplicity

Main result - implementation

Theorem

Individual income tax system $T(y,a)$ implements the optimum iff

- *balanced budget*
- $T_y^-(y^*(a,j),a) < T_y^+(y^*(a,j),a)$

  (smooth tax functions do not implement the optimum, as in Mirrlees)
- $\left[\phi(\bar{a}_j^*, j) - \phi(\bar{a}_j^*, j+1)\right] v(y^*(\bar{a}_j^*, j)) \leq T^+(y^*(\bar{a}_j^*, j), \bar{a}_j^*) - T(y^*(\bar{a}_j^*, j), \bar{a}_j^*)$

  (and analogous condition for $\underline{a}$ and T^-)

Interpretation: tax system should provide large disincentives to work after retirement, i.e. jump in taxes

Conclusion and a way forward

We develop a theoretical framework that ..

- provides a direct test of whether a tax/pension system is Pareto optimal
- qualitatively justifies large disincentives to work after retirement
  - a jump in taxes after retirement age

We are working on ..

- ways of performing the optimality test in the data
- quantitative assessment of U.S. Social Security
- optimal reforms, including in response to demographic shifts